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Financial Internet Quarterly 2025, vol. 21 / no. 3, p. 10-27

DOI: https://dx.doi.org/10.2478/fiqf-2025-0016

Financial Internet Quarterly

DO MERGERS ENHANCE FINANCIAL PERFORMANCE? EMPIRICAL EVIDENCE FROM THE CZECH REPUBLIC

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Abstract

This study investigates whether the post-merger performance of companies in the Czech Republic exceeds their pre-merger performance. Employing the Czech-specific IN05 model and internationally recognized composite financial performance indicators (Altman Z-score, Taffler model, and Kralicek Quick Test), the research utilizes a comprehensive dataset of 1,077 companies involved in mergers. The analysis spans a decade, covering five years before and after the mergers conducted in 2016. Results indicate that while the financial condition of merging companies shows stagnation, successor companies demonstrate statistically significant improvements in key financial indicators, especially during the period from 2017 to 2021. This highlights the positive impact of mergers on financial performance, even amid external disruptions such as the COVID-19 pandemic. These findings contribute to understanding M&A dynamics in medium-sized, open economies within the EU, offering valuable insights for both academic research and practical applications in corporate strategy.

JEL classification: D22, D23, G34

Keywords: Post-Acquisition Performance, Mergers, Synergies, Mixed Effect Model

Received: 18.12.2024 Accepted: 20.03.2025

Cite this:

Podškubka, T., Jahodová, L. & Arlt, J. (2025). Do mergers enhance financial performance? Empirical evidence from the Czech Republic. Financial Internet Quarterly 21(3), pp. 10-27.

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Introduction

In the early 1990s, mergers, acquisitions, takeovers, and other strategic alliances in the corporate sector became significantly more important, mainly due to fierce competition from multinational corporations and the desire to seize new opportunities. This shift resulted from liberalization measures that relaxed government controls, regulations, and restrictions, allowing corporations to expand, diversify, and modernize their operations by resorting to mergers and acquisitions (M&A). It is expected that the increase in competition and the move towards globalization will further boost the role of M&A in achieving a competitive advantage in the international market.

Based on the financial statement data, which is the primary and sometimes the only source of information for external users, various ratios can be computed to assess a merger's effects. This study determined how the individual companies' financial performance changed following mergers completed in 2016 in the Czech Republic across various industries (regardless of potential differences across the sectors and reasons for the individual companies merging). The inclusion of all 486 mergers conducted in 2016 provides a robust basis for analysing the impact of M&A on financial performance over a significant period-five years before and five years after the mergers.

This study examines the impact of M&A on financial performance. Empirical studies investigating takeover risk usually concentrate on individual aspects of financial risk or health (Kumar & Bansal, 2008; Aggarwal & Garg, 2022; Ismail et al., 2011). In contrast, this study explores how financial health, or financial risk, changes in the context of a takeover in its entirety.

In the 1990s, the Czech Republic's business landscape transformed significantly due to liberalization, reduced government control, and eased regulations, boosting M&A activity. This trend continued post-2000, establishing the country as a mid-sized, open EU economy comparable to several economies in the region. The significance of this research lies in its status as the first of its kind using data from the Czech Republic, supported by extensive datasets covering numerous M&A cases, i.e. all cases realized in 2016. By focusing on a transition economy, it provides key insights into M&A dynamics in similar markets integrating into the global economy. Its broad scope and comprehensive methodology contribute valuable findings to the M&A literature in Central and Eastern Europe, with implications for academic research and practical corporate strategy. It can be expected that the results from the Czech Republic could be applicable to countries with similar economic conditions and role of the local stock exchange (Slovakia, Slovenia, Hungary and Croatia could be typical examples). However, it is advisable that future research is conducted to explore the applicability of our findings in these countries. Due to economic similarity the same methodology and accounting-based data can be applied contrary to market-based data used in some studies from larger economies summarized in the review of the literature section. Consequently, generalizing the conclusions to countries with different market conditions should be considered with caution.

Many studies examine M&As based on individual operating performance indicators (Kalsie & Singh, 2022; Aggarwal & Garg, 2022; Alhenawi & Stilwell, 2017). The objective of this work is to analyze the transformation of overall financial health, so it is focused on comprehensive indicators rather than comparing individual operating performance indicators. By focusing on aggregate financial ratios, the overall impact of M&A on companies' financial health can be better understood. In this way, the work avoids the limitations associated with evaluating individual ratios, which may provide only a partial view of financial health. Moreover, the use of aggregate models improves comparability across different entities and sectors, which is essential for general conclusions on the effectiveness of M&A. Another reason for choosing comprehensive financial health indicators is the inconsistent findings in studies analyzing individual indicators such as profitability, leverage and liquidity.

The study employs the locally used Czech model IN05 (Neumaierová & Neumaier, 2005), which is compared with globally used models such as the Altman's Z-Score (Altman, 1968), the Taffler model (Taffler, 1983) and the Quick Test (Kralicek, 2007).

The paper is organized into four sections (in addition to the introductory and concluding parts) as follows. Section 1 reviews a theoretical framework on M&A and formulates hypotheses. Section 2 examines the literature on mergers and acquisitions, emphasizing that the results of the studies are not unambiguous, which motivates further research. Section 3 describes the source data and adopted composite financial performance indicators (bankruptcy models). It also justifies the data transformation by removing the extreme values. Section 4 both describes the testing econometric methodology and presents and discusses the results of the empirical analysis.

Theoretical framework on merger and hypothesis formulation

The world is in flux, influenced by globalization and rapid technological changes, resulting in intense business competition. Companies pursue inorganic growth to meet challenges and seize opportunities through

various strategic alternatives such as M&A, strategic alliances, and joint ventures. While organic growth is constrained by time and entails a prolonged process, inorganic growth through M&A offers a more immediate solution for achieving business growth. M&A is the most popular strategy for companies seeking a competitive advantage. The reasons for opting for mergers can be both financial and non-financial. Examples of non-financial motivations include improving corporate culture, enhancing access to new markets, expanding service or product portfolios, increasing market power, reducing competition (Ladha, 2017), and accessing new technologies or knowledge that support long-term survival (Belas et al., 2018). Diversification and risk reduction are also common motivations (Vermeulen & Bakerma, 2001). While non-financial benefits ultimately lead to financial outcomes, mergers driven by economic reasons may aim to increase company value, boost profitability, reduce costs, secure better access to financing, address financial challenges stemming from information asymmetry, and achieve tax savings.

One of the primary motivations for mergers is achieving synergistic effects, encompassing financial, operational, and managerial synergies. Companies expect that combining assets will result in lower costs, higher revenues, and more efficient resource use than operating independently. Moatti et al. (2015) caution that while synergies are often the main rationale, many mergers fail to achieve these benefits due to factors such as cultural differences, integration challenges, and market changes. Ismail et al. (2011) show that achieving synergies is possible but requires thorough analysis and change management. Ladha (2017) emphasizes that, particularly in the public sector, governments can use the prospect of mergers as leverage to push organizations toward meeting societal objectives or improving their global competitiveness. Oh and Johnston (2021) highlight that the duration of post-merger integration (PMID) plays a critical role in merger success, with slower, well-structured integration potentially enhancing trust and minimizing disruptions.

Mergers are also driven by the desire to gain market power and strengthen competitiveness. Hitt et al. (2007) note that mergers can expand market share, access new technologies, and mitigate risks associated with new product development. In a rapidly evolving global market, mergers help companies enter new markets or consolidate their positions. Belas et al. (2018) emphasize that mergers can provide resources for innovation and enhance financial stability, crucial for SMEs seeking sustainable growth.

Financial synergies may involve reducing capital costs or improving capital utilization. Gupta et al. (2023) show that well-implemented financial synergies can lead to significant profitability gains through better credit access and efficient asset use. Mergers also facilitate growth and diversification, allowing firms to enter new markets and broaden their product offerings. Vermeulen and Bakerma (2001) argue that mergers can revitalize companies by bringing in new knowledge and strengthening long-term viability. Diversification mergers help mitigate operational risks by extending the company's portfolio, enhancing resilience to economic fluctuations.

However, mergers can have adverse effects, such as high integration costs due to differing corporate cultures (Oh & Johnston, 2021), decreased employee motivation, internal process disruptions, and challenges related to corporate identity (Pepper & Larson, 2006). Negative responses from customers and suppliers, management and control issues, legal and regulatory hurdles, overestimation of merger benefits, and lost profit (Nohýnková, 2022) are potential risks. Furthermore, mergers may result in the loss of key employees, including top management (Krishnan et al., 2007).

Agency theory suggests that mergers can be driven by managerial interests rather than shareholder value, leading to inefficiencies (Jensen, 1986). Chen et al. (2020) discuss the impact of these conflicts on outcomes, while Li and Singal (2021) show that mergers can act as governance mechanisms aligning managerial incentives with shareholder interests.

Based on the theoretical framework and the specific context of this study, the following hypotheses are formulated to examine the financial performance of companies before and after mergers:

H_1: The dynamics of the financial performance of successor companies due to the merger are higher than those of the merging companies.

H_2: The level of the financial performance of successor companies due to the merger is higher than that of the merging companies.

Literature review

The literature examines M&A from many perspectives. Two specific aspects are important for this paper: the effect of mergers on financial performance, and the risk of failure.

The positive impact of mergers and acquisitions on financial performance

Adhikari et al. (2023) found that the financial performance of commercial banks improved significantly after the M&A, as measured by liquidity and leverage ratios. However, the ratios of profitability and shareholder wealth show either no change or a marginal change after the M&A. Kalsie and Singh (2022) found that synergistic advantages of M&A appear to be perceived by enhanced operating income, improvement in

expenditure and a positive return on assets. Cao et al. (2022) examined the impact of coordination capabilities provided by enterprise systems (ES) on M&A outcomes in the short and long term. They revealed that it is the ES extensiveness of the acquirer that improves long-term performance i.e., decreases goodwill impairment and increases operating performance. Das (2021) revealed positive long-term performance is strongly connected with the acquirer´s R&D intensity and intangible assets, suggesting that acquirers are able to leverage their intangible assets toward innovative results post-acquisition. He found that long-term financial performance was positively influenced by leverage and negatively influenced by the acquirer's stake ratio, suggesting the presence of an agency effect. Kumar and Bansal (2008) examined the ability of companies to create financial and operational synergies using Indian data. They concluded that, in most cases, companies can increase their operating profit and profit before tax after the merger. The merger is associated with increased working capital, return on equity, and earnings per share. The authors claim that management cannot take for granted that mergers and acquisitions alone can achieve synergies and profit increases. Ismail et al. (2011) studied the operating performance of a sample of Egyptian companies involved in M&A transactions from 1996–2003. The analysis was based on the accounting ratios to examine the effect of the M&A transactions on firm performance. The authors conclude that some corporate performance indicators, such as profitability, indicate statistically significant increases in the years following the M&A. Other performance measures, such as efficiency, liquidity, solvency, and cash flow position, do not show significant improvements in the short period after the merger. Alhenawi and Stilwell (2017) explored all the U.S. mergers and acquisitions completed between 1998 and 2010. They found that M&A creates value over the long run and that the gain is proportional to the acquirer's historical performance, competence, and target value before the acquisition. According to this study, the liquidity position of the acquirer and lower debt levels positively impact the post-acquisition performance, contrary to Jensen (1986). Aggarwal and Garg (2022) monitored the merger's impact on the acquiring company's accounting performance. They analyzed data on 68 mergers between 2007-08 and 2011-12, examining five years before and after the merger. They found that the merger significantly impacted the acquiring firm's profitability and liquidity over the five years. Still, they did not have a substantial impact on the solvency of the firm. Gupta et al. (2023) looked into the effect of mergers and acquisitions on the financial performance of the construction and real estate industries. They used a wide range of financial ratios. Mergers and acquisitions that took place from 2014 to 2017 were examined. M&A from 2014 to 2017 were studied three years before and three years after the merger. After analysis of 70 companies, they concluded that the financial performance of Indian construction and real estate companies generally improved in the post-merger and post-acquisition periods.

The neutral impact of mergers and acquisitions on financial performance

Borodin et al. (2020) explored the influence of M&A transactions on the financial performance of US and European companies. They studied the sample of 138 M&A transactions performed within these two regions during the period between 2014 and 2018. Most of the corporations studied both in the USA and in Europe were profitable, and remained so after mergers and acquisitions. They found that regression analysis did not reveal a significant relationship between mergers and acquisitions and company performance. Dutta and Jog (2009) investigated Canadian acquiring firms' long-term stock return performance in the post-M&A period using 1,300 M&A transactions in 1993–2002. After accounting for methodological discrepancies, they found neither negative abnormal long-term stock market returns nor negative long-term operating performance in the post-acquisition periods for the acquirer following an acquisition event. They also found that the Canadian market reacts positively to acquisition announcements but corrects this reaction within a short period. They found that Canadian acquisitions do not show value destruction or overpayment. Martynova et al. (2007) investigated the long-term operating performance of 155 European corporate M&A completed between 1997 and 2001. The first main result was that the combined operating performance of the acquirer and target does not change significantly following mergers, whereas their unadjusted "raw" operating performance declines significantly. Secondly, they found that the acquirer and target significantly outperformed their industry median peers before the merger. Thirdly, they found that the post-acquisition performance of the combined firm varies significantly across the M&As with different characteristics: hostile versus friendly, tender offers versus negotiated deals, and domestic versus cross-border transactions. Furthermore, the cash reserves of the acquiring firm before the bid and the relative size of the target firm are essential determinants of the post-acquisition profitability.

Mergers and acquisitions from the perspective of default risk

Chen et al. (2020) dealt with the financial risk and shareholder wealth of acquirers in M&A transactions. One study result is that acquirers have low financial risk when measured by Altman's Z-score. The authors fur-

ther conclude that the lower the default risk of an acquirer, the higher the probability of a successful takeover. Among other things, they found that takeovers create value for the acquirer but with a higher risk of default.

Data and financial performance indicators

Data collection and sample selection

The data for this study were collected from multiple sources, including the Czech Commercial Register, the Commercial Bulletin, and the Orbis Europe database. The initial list of all mergers realized in the Czech Republic in 2016 was compiled by Sládková (2018), encompassing 638 merging companies and 439 successor companies. In more detail, the dataset was compiled by exploring the Commercial Bulletin, where all realized mergers must be noted, including the publication of electronic versions of merger projects, which can be downloaded from the Business Register. The merger projects contain information about all participating companies, i.e., the so-called merging companies and the successor company, including their IDs and further legal specifications. Based on the ID of each company, financial data was obtained from the Orbis Europe database and assigned to the individual companies in the dataset. This financial data contains information from the companies' balance sheets, such as the value of total assets, long-term assets, inventory or equity, long-term liabilities, and short-term liabilities, and from their profit and loss accounts, including sales volume, costs, and various profit levels. These primary indicators were used to calculate financial performance indicator IN05 as the locally used model. This model serves as a benchmark for comparative analysis with globally recognized models such as the Altman Z-Score, the Taffler model, and the Kralicek Quick Test.

All mergers that occurred in the Czech Republic in 2016 were considered for this analysis. The study examined the five-year periods pre and post the mergers, specifically the years 2011–2015 and 2017–2021. These five-year intervals were chosen to ensure robust trend analysis. The year 2016 was designated as the merger year, taking into account the typical delay in financial disclosures by companies and considering financial results for 2021 were made available no earlier than in late 2023.

Selecting 2016 as the focal year is further justified by macroeconomic indicators, which suggest that it was a representative and comparable year within the post 2008/2009 financial crisis and pre-COVID lockdown period i.e. 2011–2019. This period was characterized by stable economic growth, low inflation, and low unemployment in the Czech Republic, creating a favorable business environment that encouraged M&A activity. Additionally, the political stability provided by the country's full integration into the European Union offered a consistent regulatory framework for corporate transactions. These factors collectively ensure that 2016 serves as a solid basis for examining pre- and post-merger trends in this paper.

Composite financial performance indicators

To verify the formulated hypotheses, the following composite financial performance indicators (bankruptcy models) are calculated from the raw financial data:

Index IN05

Index IN group of models – Index IN95, Index IN99, Index IN01, and Index IN05 (Neumaierová & Neumaier, 2005) are frequently used in the Czech Republic. These models are suitable to the local conditions of the Czech market. The IN95 model was developed in 1995 to predict corporate bankruptcies. In 1999, aiming to better understand and quantify the link to value creation, the IN99 index was created. This index expanded the original model by incorporating a dimension of value-creation capabilities, thereby enabling a more comprehensive assessment of a company's financial health. In 2002, both models, IN95 and IN99, were integrated into the new IN01 index. This unified index encompassed aspects of bankruptcy risk as well as creditworthiness and value-creation ability. Finally, in 2005, the IN05 model was developed based on industrial sector data from 2004.

This paper uses the most recent of these models, IN05, which has the following formula:

$$IN05 = 0.13x_1 + 0.04x_2 + 3.97x_3 + 0.21x_4 + 0.09x_5 \quad (1)$$

where: x_1 = total assets / liabilities
x_2 = EBIT / interest expense
x_3 = EBIT / total assets
x_4 = revenues / total assets
x_5 = current assets / current liabilities.

The formula is evaluated according to Table 1.

Table 1: Index IN05 evaluation

Value of IN05	Zone of discrimination
IN05 > 1.6	Safe zone, prosperous companies
0.9 < IN05 < 1.6	Grey zone
IN05 < 0.9	Non-prosperous companies

Source: Neumaierová, I. & Neumaier, I. (2005). Index IN05. In: Červinek, P. & Valouch, P. (Eds.) Evropské Finanční Systémy – Proceedings of the international expert conference. Masarykova Univerzita, Brno.

Altman Z-Score model

Altman's Z-Score is the earliest comprehensive accounting-based model. First published by Altman (1968), in later studies it was further elaborated and improved (Agarwal & Taffler, 2007; Edmister, 1972; Goudie, 1987; Sandin & Porporato, 2007; Taffler, 1983).

The Altman formula is based on multivariate discriminant analysis developed from the US-listed companies. It consists of five variables with different weights. This paper will use it in the version for non-publicly traded companies, which has the following formula:

$$Z = 0.717x_1 + 0.847x_2 + 3.107x_3 + 0.42x_4 + 0.998x_5 \quad (2)$$

where: x_1 = (current assets – current liabilities) / total assets
x_2 = retained earnings / total assets
x_3 = EBIT / total assets
x_4 = book value of equity / total liabilities
x_5 = sales / total assets

It is evaluated according to Table 2.

Table 2: Zones of discrimination according to Altman Z-score

Value of Z	Zone of discrimination
Z > 2.90	Safe zone, prosperous companies
1.23 < Z < 2.90	Grey zone
Z < 1.23	Distress zone, non-prosperous companies

Source: Altman, E.I. (2018). A fifty-year retrospective on credit risk models, the Altman Z-score family of models and their applications to financial markets and managerial strategies. Journal of Credit Risk, 14(4), 1-34, https://dx.doi.org/10.21314/JCR.2018.243.

Taffler model

The Taffler model (Taffler, 1983) considers the four crucial dimensions of the firm's financial profile: profitability, working capital position, financial risk, and liquidity.

Agarwal and Taffler (2007) examined the performance of the Taffler model twenty-five years after its introduction. They demonstrated that this model continues to have significant value for financial statement users concerned about corporate credit risk and firm financial health. In contrast to ad hoc conventional one-at-a-time financial ratio calculation in financial analysis, the value of adopting a formal multivariate approach is evident. Dufková et al. (2023) have studied the model in the Czech Republic, particularly in the context of its misapplication.

The model has the following formula:

$$z = 3,20 + 12,18x_1 + 2,50\ x_2 - 10,68x_3 + 0,029x_4 \quad (3)$$

where: x_1 = profit before tax / current liabilities
x_2 = current assets / total liabilities
x_3 = current liabilities / total assets
x_4 = "no-credit interval", computed as (quick assets - current liabilities) / daily operating expenses with the denominator proxied by (sales - PBT - depreciation / 365)

Firms with computed z-score < 0 are at risk of failure; those with z-score > 0 are financially solvent.

Kralicek quick test

Kralicek Quick Test (Kralicek, 2004) is frequently used in German-speaking countries. This approach consists of four indicators: stability, liquidity, profitability, and economic results. Each indicator is assigned a grade from 1 to 5 (1 being the best and 5 the worst) and the resulting assessment represents their average. It should be noted that although previous models preferred higher values (better financial health), the Kralicek Quick Test prefers lower values. Lower grades indicate better financial health. It is evaluated according to Table 3.

Table 3: Kralicek Quick Test evaluation

Ratio/Grade	1	2	3	4	5
Equity / total assets	> 30%	> 20%	> 10%	< 10%	Negative
(Liabilities – short-term financial assets) / operating cash-flow	< 3 years	< 5 years	< 12 years	< 30 years	>30 years
EBIT / total assets	> 15%	> 12%	> 8%	< 8%	Negative
Operating cash-flow / sales	> 10%	> 8%	> 5%	< 5%	Negative

Source: Kralicek, P. (2004). Bilanzen lesen – eine einführung: Keine angst vor kennzahlen. Redline Verlag, Munich.

Descriptive statistics

The following tables summarize the descriptive statistics of the composite financial performance indicators calculated from the data described in Section 2.1, first for the analyzed merging companies' subset (Table 4) and then for the successor companies' subset (Table 5).

Table 4: Merging companies

IN05					
Variables	**2011**	**2012**	**2013**	**2014**	**2015**
Count	208.00	228.00	238.00	229.00	129.00
Min	-331.32	-2,975.37	-411.60	-28.16	-128.74
Max	88.36	6,637.42	236.55	2,160.06	485.77
Median	0.53	0.65	0.66	0.63	0.78
Mean	0.55	19.44	1.20	27.44	3.74
Standard deviation	14.95	288.21	22.10	124.79	20.10
Skewness	-9.74	10.31	-5.26	9.57	9.60
Kurtosis	126.32	163.17	81.66	95.61	107.90
Altman					
Variables	**2011**	**2012**	**2013**	**2014**	**2015**
Count	379.00	408.00	435.00	418.00	233.00
Min	-3,699.64	-2,231.39	-3,735.16	-1,602.01	-927.43
Max	2,598.25	13,049.20	1,408.39	7,027.86	2,982.36
Median	1.11	1.72	1.54	1.43	1.60
Mean	0.60	31.27	0.62	42.13	12.34
Standard deviation	194.33	529.42	177.04	412.46	128.09
Skewness	-5.74	18.53	-11.86	12.17	11.45
Kurtosis	155.24	368.94	220.63	163.41	168.77
Taffler					
Variables	**2011**	**2012**	**2013**	**2014**	**2015**
Count	242.00	267.00	273.00	271.00	147.00
Min	-2,675.53	-1,798.77	-7,649.81	-1,886.04	-10,985.75
Max	2,128.12	3,446.99	8,852.92	23,291.21	642.33
Median	1.14	1.01	-2.15	-1.13	4.95
Mean	-25.15	12.05	38.01	39.49	-480.29
Standard deviation	167.11	206.30	551.96	938.41	979.77
Skewness	-2.99	4.66	2.70	15.53	-4.01
Kurtosis	58.76	60.18	74.14	252.86	15.06
Quick Test					
Variables	**2011**	**2012**	**2013**	**2014**	**2015**
Count	232.00	248.00	257.00	256.00	135.00
Min	1.00	1.00	1.00	1.00	1.00
Max	4.75	4.75	4.50	4.75	4.25
Median	2.75	2.75	3.00	2.75	2.50
Mean	2.71	2.68	2.77	2.73	2.60

Quick Test					
Variables	2011	2012	2013	2014	2015
Standard deviation	1.42	1.44	1.49	1.47	1.16
Skewness	-0.26	-0.16	-0.36	-0.22	-0.05
Kurtosis	-0.87	-0.85	-0.97	-0.95	-1.13

Source: Authors own work.

The count of values in individual years is typically higher than 200 values. The most values were available for Altman, almost 1,900 in total, while for IN05, only more than 1,000 values were available. In 2015, the data count was considerably smaller than in other years. The lower count might be caused by the upcoming mergers as the management could prefer not to disclose the latest pre-merger financials that are not so relevant and focus on the post-merger numbers of 2016.

The descriptive statistics for Altman, IN05, and Taffler are similar. Min and max values as well as standard deviation values signal a considerable level of variability in the dataset. Most medians are lower than the means, representing the data skewness to the right, confirmed by the positive skewness index in most analyzed years. High kurtosis indicates a considerable concentration of the values around the median and mean.

Quick Test dataset exhibits a somewhat different data structure caused by the construction of this index given by the distribution of values according to five predefined grades. Min and max values correspond to the limit values of Kralicek's grades. Medians and means are almost identical. Skewness and kurtosis of the data are very moderate.

Table 5: Successor companies

IN05					
Variables	2017	2018	2019	2020	2021
Count	264.00	248.00	237.00	229.00	181.00
Min	-675.49	-218.50	-715.99	-436.62	-123.11
Max	4,906.78	7,284.93	1,387.84	875.26	1,084.92
Median	0.96	0.86	0.98	1.04	1.10
Mean	49.32	40.17	6.96	15.63	15.28
Standard deviation	345.88	355.80	77.34	71.44	62.02
Skewness	9.36	14.65	8.45	5.94	8.96
Kurtosis	90.99	224.53	135.86	49.40	91.93
Altman					
Variables	2017	2018	2019	2020	2021
Count	347.00	330.00	319.00	303.00	225.00
Min	-168.55	-35.38	-89.13	-489.46	-14.76
Max	6,027.84	829.74	14,786.02	4,696.69	790.72
Median	1.75	1.73	1.84	1.99	2.42
Mean	23.42	11.92	67.46	24.63	8.98
Standard deviation	288.75	61.68	714.92	233.06	42.06
Skewness	18.25	8.88	17.04	15.50	11.59
Kurtosis	339.32	85.23	300.21	257.24	147.87
Taffler					
Variables	2017	2018	2019	2020	2021
Count	318.00	304.00	293.00	276.00	216.00
Min	-5,432.88	-1,379,255.72	-43,870.11	-626.28	-4,097.42
Max	637,434.25	23,298.02	91,186.50	115,634.77	144,976.70
Median	3.99	4.06	3.64	4.18	7.60
Mean	2,190.21	-4,445.02	362.59	611.73	695.58
Std. deviation	30,521.61	65,792.48	5 127.65	5,775.55	6,922.02
Skewness	17.52	-17.32	9.69	14.69	14.53
Kurtosis	312.19	303.33	160.88	229.25	214.60

Quick Test					
Variables	2017	2018	2019	2020	2021
Count	281.00	278.00	277.00	262.00	203.00
Min	1.00	1.00	1.00	1.00	1.00
Max	4.75	4.50	4.75	4.50	4.75
Median	2.75	2.75	2.75	2.50	2.50
Mean	2.63	2.63	2.64	2.54	2.48
Standard deviation	1.43	1.45	1.44	1.43	1.37
Skewness	-0.11	-0.14	-0.07	-0.02	-0.01
Kurtosis	-0.67	-0.93	-0.79	-0.90	-0.75

Source: Authors own work.

The total number of values for the Altman model is 1,524; the Taffler model provides 1,407 numbers, the IN05 model works with 1,159 numbers, and the Quick Test with 1,301 values. The number of values in 2021 is smaller than in other years because the companies disclosed financial information with some delay, and some data for 2021 has yet to be available.

As can be seen from descriptive statistics, the Altman, IN05, and Taffler datasets contain outliers, mainly the maximums. The skewness is, therefore, positive in most of the analyzed years. High kurtoses indicate that values are considerably concentrated around the medians and means. The Quick Test dataset, on the contrary, shows no extremes. Min and max values lie in the expected boundaries of Kralicek's grades. Medians and means reach similar values. Skewness and kurtosis confirm a non-peaked and relatively symmetrical value distribution.

Elimination of outliers

The outliers were removed to eliminate companies with extraordinary financial statements that were typically operating in a specific industry or performing unusual business activities, which cannot be verified appropriately by the traditional composite financial performance indicators. These outliers mainly included real estate and holding companies, companies with no debt or debt interest, and companies generating high losses or high sales and profits with virtually no assets. The detailed data also show that the companies with very high values disclosed uncommon accounting figures in their financial statements and as such they are not representatives of the population. Another fundamental reason was statistical; the effort was to bring the dataset closer to a normal distribution. Removal of outliers was done as follows:

1) Index IN 05: Values outside the interval <-1; 5> were removed.
2) Altman Z-score: Values outside the interval <0; 6> were removed.
3) Taffler model: Values outside the interval <-30; 30> were removed.

In the merging companies' dataset, 498 companies remained for IN05, 334 companies for Altman, and 442 companies for Taffler out of the original 638 companies for each model. In the successor companies' dataset, 335 companies remained for IN05, 303 companies for Altman, and 285 for Taffler out of the original 439 companies for each model. No elimination was necessary for the Quick Test dataset because it proved close to a normal distribution. All datasets include missing values.

Methodology and results

The dynamics of the financial performance of successor companies due to the merger are higher than those of the merging companies

It is appropriate to use the linear trend mixed effect model to verify whether the dynamics of the time development of companies after mergers are higher than before. This kind of model is an original contribution of the authors; the model has been developed specifically for this study. As far as the authors know, this model has not yet been applied in economic studies. It has the following formula:

$$y_{it} = \alpha + \beta_t + \varepsilon_{it}, i = 1, N, t = 1, ..., T \qquad (4)$$

where: the dependent-analyzed variable $y_{i,t}$ is indexed by the company (i) and time (t). Time t is an exogenous variable whose purpose is to capture the development trend of the analyzed variable. The intercept α and the regression parameter β are denoted as fixed effects, meaning they are the same for all observations of the analyzed variable. The parameter β is interpreted as the mean increment of the analyzed variable during the unit growth of the time variable. The component δ_i expresses the corporate effect, which is specific to each company and has a random character; it is therefore referred to as a random effect. It is assumed that random effects form a set of identically distributed and independent random variables, i.e. $\delta_i \sim IID(0, \sigma^2_\delta)$. The idiosyncratic error terms ε_{it} also form a set of equally distributed independent random

variables, i.e. $\varepsilon_{it} \sim IID(0, \sigma^2_\varepsilon)$ It is further assumed that random effects di and idiosyncratic components eit are independent.

All computations were performed using the software package EViews 11. The econometric model was applied to IN05, Altman, Taffler and Quick Test indicators. As mentioned above, the outliers were removed from the data. Missing values were left untreated.

All data were subsequently tested for normality in years and overall using the Jarque Bera test (Jarque & Bera, 1980). Slight skewness was detected; in some cases, the hypothesis of normality was not rejected at all. Schielzeth et al. (2020) proved that even for datasets significantly smaller than the ones used in this study, the feasible GLS (Baltagi, 2013) provides very robust estimates of the parameters of the Model (4) even when the condition of normality is severely violated. Therefore, the results of this analysis can be considered very reliable from this point of view.

A comparison of the quality of the models for the above indicators for merging and successor companies shows that the successor ones are better. In most cases, these models have a higher determination index and a lower residual standard deviation (idiosyncratic standard deviation). The standard deviations of cross-section random effects and the Durbin-Watson statistics are nearly identical. Durbin-Watson statistics points to moderate autocorrelation, leading to the bias of the standard error estimates, which could result in a distortion of the t-tests. This danger is solved by computing their robust versions using the Panel Corrected Standard Errors (PCSE) method (Beck & Katz, 1995).

Table 6 and Table 7 contain point estimates of the fixed effects, i.e. parameters β of the Model (4) based on the time periods delimited by the years indicated in the legend and in the table header for individual indicators. Some of these estimates are marked with asterisks, indicating the P-value level. For example, the last value in the second row in Table 6 expresses that from 2011 to 2015, the value of the IN05 grew on average by 0.0405 per year. Since this value is not marked with an asterisk, it is not statistically significant, meaning that the hypothesis that the corresponding fixed effect, i.e., b parameter in the Model (4) is zero, is not rejected. The growth of the IN05 is, therefore, not statistically proven in this period. On the contrary, the value in the sevenths row and penultimate column in Table 7 says that from 2018 to 2020, Altman grew on average by 0.0747 per year. This value is marked with three stars, indicating its statistical significance and rejection of the hypothesis that the fixed factor is zero at the 1% significance level. The growth of Altman in this period is, therefore, statistically proven.

Table 6: Fixed effects from the Model (4) for merging companies

Year	Variables	2012	2013	2014	2015
2011	IN05	0.0719	0.0101	0.0220	0.0405
	Altman	0.0146	0.0090	-0.0127	-0.0038
	Taffler	-0.1387	-0.2549	-0.0272	0.2877
	Quick	-0.0442	0.0019	-0.0130	-0.0305*
2012	IN05		-0.0365	0.0190	0.0459
	Altman		0.0049	-0.0269	-0.0047
	Taffler		-0.3825	0.1355	0.6609
	Quick		0.0481	-0.0159	-0.0405*
2013	IN05			0.0791	0.0878*
	Altman			-0.0552	0.0214
	Taffler			0.3180	1.2647**
	Quick			-0.0600	-0.0752**
2014	IN05				0.1206
	Altman				0.1471
	Taffler				2.6804**
	Quick				-0.1086*

Notes: The point estimates of the fixed effect parameter b from the model $y_{it} = \alpha + \beta_t + \delta_i + \varepsilon_{it}$ are based on the periods delimited by the years indicated in the legend and the table header. Asterisks denote statistical significance: *** p < 0.01, ** p < 0.05, * p < 0.1

Source: Authors own work.

In Table 6, where the results of the analysis of merging companies are presented, it can be seen that there are very few values marked with asterisks. Statistically significant growth for the Taffler and decrease for the Quick Test were recorded from 2013 to 2015, and growth for the Taffler was from 2014 to 2015. Other significant changes were recorded only at a 10% significance level. In contrast, in Table 7, where the suc-

cessor companies´ results are presented, there is a high number of three-star values in the last column, indicating statistically significant average annual increases between the given year and 2021 (respectively, statistically significant decrease for the Quick Test indicator). It can be seen that the dynamics of the indicators were weak in the initial periods, and the acceleration occurred mainly in 2021.

The values in the last four rows and the last column in Table 7 show what the change in the individual models was from 2020 to 2021, i.e., during the COVID-19 pandemic in the Czech Republic. The values of the IN05 and Taffler models are marked with three stars, and the value of the Altman model by two stars, indicating their statistically significant growth at the 1% and 5% significance levels, respectively. The statistically insignificant value of the Quick Test is the only one in the last column of the table, and it may signal a slight slowdown in growth in this COVID-19 period. However, comparing the results of the Quick Test with other models can be problematic because this model is constructed in principle differently, which can lead to opposite conclusions; this is evident in Table 6. Overall, the results show that the COVID-19 pandemic did not slow down the growth of post-merger companies in the Czech Republic.

The dynamics of the average development of individual indicators over the entire five-year period are shown in Figure 1. The lines on the left side of the figure represent the merging companies, where no statistically significant development of the indicators was recorded, although the Taffler's growth seems to be quite sharp. The statistically significant rising lines for Altman, IN05, and Taffler and the falling one for the Quick Test show a positive development of the successor companies from 2017 to 2021, even though Altman and IN05 are still moving in the grey zone.

Table 7: Fixed effects from the Model (4) for successor companies

Years	Variables	2018	2019	2020	2021
2017	IN05	-0.0953	-0.0091	0.0337	0.0692***
	Altman	-0.0298	0.0506*	0.0467***	0.0553***
	Taffler	0.2158	-0.1041	0.1577	0.5061***
	Quick	0.0376	0.0115	-0.0239	-0.0338***
2018	IN05		0.0732	0.0818**	0.1189***
	Altman		0.1160***	0.0747***	0.0801***
	Taffler		-0.3264	0.2805	0.7435***
	Quick		0.0115	-0.0480**	-0.0531**
2019	IN05			0.0882*	0.1470***
	Altman			0.0200	0.0604*
	Taffler			0.8752	1.2901***
	Quick			-0.1066***	-0.0705***
2020	IN05				0.1835***
	Altman				0.1018**
	Taffler				1.6503***
	Quick				-0.0465

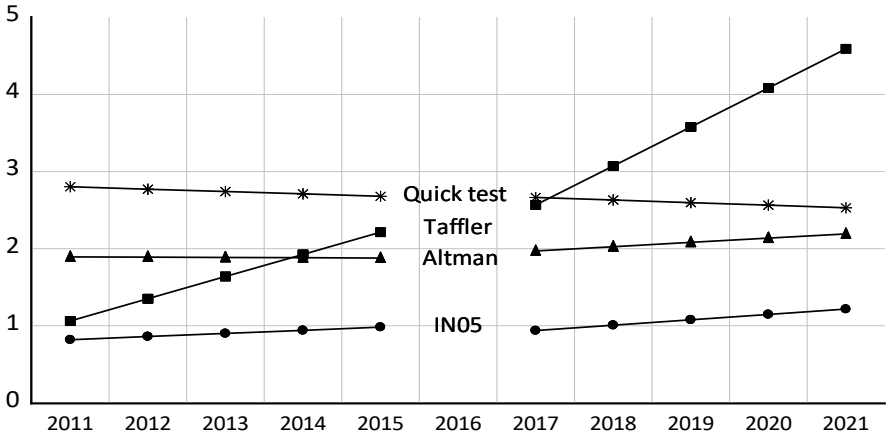
Note: Notes: The point estimates of the fixed effect parameter β from the model $y_{it} = \alpha + \beta_t + \delta_i + \varepsilon_{it}$ are based on the periods delimited by the years indicated in the legend and the header of the table. Asterisks denote statistical significance: *** p < 0.01, ** p < 0.05, * p < 0.1

Source: Authors own work.

The level of the financial performance of successor companies due to the merger is higher than that of the merging companies

Student's t-test of equality of means, where the variances of the two populations are assumed equal, is used to verify that Altman, IN05, and Taffler levels are higher and the Quick Test is lower for the successor companies compared to the merging companies (Snedecor & Cochran, 1989). The Student's t-test assumes that the two populations for which the mean values are tested are normally distributed. It was shown above that this requirement is not met by the analyzed data sets. However, Lumley et al. (2002) showed that for large data sets, the Student's t-test is robust even to the severe violation of data normality. As the analyzed data sets are sufficiently large, the application of the Student's t-test is justified. Ficher's F-test (Snedecor & Cochran, 1989) examines the equality of variances. Because it also assumes normality, its results are supported by the application of Levene's test (Levene, 1960), not requiring this condition.

Figure 1: Fixed effects from the Model (4) for merging (left) and successor (right) companies computed from the five-year intervals



Source: Authors own work.

Table 8 contains the results of the Student's t-test. Specifically, the table contains the test criterion for a pair of files determined by the names of the indicator in the legend and the years in the legend and header. Some of these values are marked with asterisks, indicating the P-value level. For example, the number 3.084055 in the second row and penultimate column of the table gives the test result that compares Altman for successor companies in 2021 with the same indicator for merging companies in 2011. Three stars denote that the null hypothesis of equality of means was rejected at a 1% significance level. In the numerator of the test criterion, the average value of the year 2011 is subtracted from the average value of the year 2017, a positive value of the test criterion therefore expresses a higher level of the indicator in 2017. Prior to using this test, Fischer's F-test and Levene's test were used to test the hypothesis that the variances of the analyzed pairs of populations are the same. In the vast majority of cases, this hypothesis was not rejected. However, if it was, the result of the Student's t-test was verified using the Welch-Satterthwaite t-test, which does not assume equality of variances and also proves robust to violations of the normality condition for extensive data sets. Nevertheless, the results of the Student's t-test and Welch-Satterthwaite's t-test criteria are the same even in these rare cases.

Table 8: Analysis of differences in the indicators means of successors and merging companies

Year	Variables	2017	2018	2019	2020	2021	2017-21
2011	IN05	1.7873*	1.1644	1.9831**	2.5291**	3.8372***	
	Altman	1.1235	0.9215	1.8316*	2.1311**	3.0841***	
	Taffler	0.9003	1.1660	0.9657	1.6425	3.2893***	
	Quick	-0.9396	-0.8753	-0.8387	-2.0083**	-2.6376***	
2012	IN05	1.3510	0.6589	1.5095	2.1323**	3.5313***	
	Altman	1.0589	0.8524	1.7778*	2.0831**	3.0491***	
	Taffler	0.8986	1.1745	0.9630	1.6694*	3.3638***	
	Quick	-0.5553	-0.5016	-0.4580	-1.6439	-2.2725**	
2013	IN05	1.5220	0.8488	1.6799*	2.2858**	3.6527***	
	Altman	0.7590	0.5493	1.4880	1.8001*	2.7906***	
	Taffler	1.2930	1.5565	1.3531	2.0232**	3.6246***	
	Quick	-1.7000*	-1.6189	-1.5920	-2.7400***	-3.3113***	
2014	IN05	0.8657	0.1457	0.9592	1.6378	3.0425***	
	Altman	0.9871	0.7784	1.7207*	2.0322**	3.0297***	
	Taffler	1.1885	1.4587	1.2502	1.9390*	3.5830***	
	Quick	-1.2400	-1.1700	-1.1364	-2.2978**	-2.8914***	
2015	IN05	-0.3475	-1.0998	-0.3519	0.3693	1.6970*	
	Altman	1.1080	-0.4608	0.3465	0.6216	1.5495	
	Taffler	-1.1147	-0.8791	-1.0940	-0.4337	1.0018	
	Quick	0.2976	0.3218	0.3717	-0.6460	-1.2431	

Year	Variables	2017	2018	2019	2020	2021	2017-21
2011-15	IN05						3.4360***
	Altman						3.1982***
	Taffler						3.0378***
	Quick						-3.0665***

Notes: Student's t-test of equality of means assumes that variances of two populations are equal. Fischer's F-test and Levene's test are used to test the equality of variances before applying the Student's t-test. In the numerator of its test criterion, the average of the indicator of the merging companies is subtracted from the average of the indicator of the successor companies. Asterisks denote statistical significance: *** p < 0.01, ** p < 0.05, * p < 0.1

Source: Authors own work.

The results in Table 8 show that the indicators of the successor companies in 2017 and 2018 are not significantly different from the levels of these indicators for the merging companies in all the years under consideration. The situation started to change slightly in 2019; for some indicators, the hypothesis of equality of means was rejected at the 10% level, in the case of IN05 at 5%. In 2020, the hypothesis of equality was rejected for the Quick Test at 1% (in this case, a negative value of the test criterion indicates an improvement); in other cases, the null hypothesis is mostly rejected at 5%. A clear improvement of the successor companies compared to the merging ones is shown in 2021, where for most indicators, the null hypothesis is rejected at 1%, and the values of the test criteria are positive, except for the Quick Test. In the last column and the last four rows, the indicators of successor and merging companies are compared for the entire five-year period. All indicate an improvement, as the hypothesis of equality of means is rejected at 1%.

Discussion

H_1: The dynamics of the financial performance of successor companies due to the merger are higher than those of the merging companies.

The justification for this hypothesis is based on a statistical analysis based on data on the financial performance of the companies involved in the mergers. The results show that successor companies generally experience significant improvements in key financial ratios such as IN05, Altman Z-score and Taffler model in the years following the merger. Specifically, the findings show that while merging companies often exhibit stagnation or limited growth, successor companies show clear and statistically significant positive trends in these financial ratios post-merger. This trend suggests that mergers allow for better operational efficiency, better resource allocation and potential financial synergies, which contribute to increased financial stability and performance post-merger. Improvements in financial performance for the successor companies were found throughout the 2017-2021 period, with positive trends evident despite economic challenges such as the COVID-19 pandemic. This growth indicates the ability of mergers to deliver synergies, optimize operations and improve financial stability, supporting the hypothesis of higher financial performance dynamics for successor companies compared to merging firms.

H_2: The level of the financial performance of successor companies due to the merger is higher than that of the merging companies.

The analysis of the financial performance of the acquiring and merging companies confirms that the level of financial performance of the acquiring companies after the merger is higher than that of the merging companies. The Student's t-test of equality of means, which was used to compare ratios such as IN05, Altman's Z-score, Taffler's model and the Quick Test, showed significant improvement for the successor companies. The improvement was particularly noticeable in 2021, when the values of all key models (except the Quick Test) were statistically significantly higher than those of the merging companies. When the full five-year pre- and post-merger periods were compared, it was confirmed that the successor companies achieved higher levels of financial stability and performance, highlighting the benefits of mergers in terms of better resource management and synergies. Thus, the hypothesis is supported by clear and statistically significant results.

Our examination of the impact of mergers on the financial performance of companies in the Czech Republic is of considerable academic interest. In a globalized economy, numerous economic processes are interdependent. Our research is based on a substantial dataset from the Czech Republic. The Czech economy is a typical medium-sized open market economy within the EU, closely integrated with major European economies, particularly Germany, and operates within the conventional economic frameworks recognized internationally. Consequently, we deemed it appropriate to utilize classical composite financial performance indicators (Altman, Taffler and Quick Test), which, despite their origins in different markets, continue to be widely applied globally. Additionally, for comparative purposes, we incorporated the purely Czech indicator IN05. To our knowledge, this research, which leverages unique

data and employs original econometric methodology, represents a pioneering effort. Therefore, its findings could be highly relevant for further investigations in this domain and may have potential applications in other similar open market economies akin to the Czech Republic.

Our findings indicate that mergers can serve as a strategic instrument for augmenting the financial performance of companies (therefore consistent with e.g. Alhenawi & Stilwell, 2017; Aggarwal & Garg, 2022; Gupta et al., 2023). The enhanced financial stability of successor companies post-merger demonstrates that such corporate strategies can result in more robust and resilient business entities (e.g. by reducing the number of competitors; Ladha, 2017), which we regard as a primary scientific contribution of our study. This insight is particularly pertinent for economies akin to the Czech Republic, where globalization and market dynamics exert significant influence. Another noteworthy contribution of this research is its foundation on authentic data derived from a comprehensive analysis of financial performance ratios calculated from the financial statements of 1,077 companies. This study employed novel analytical methodologies, integrating several composite financial performance indicators through advanced statistical techniques.

While the results are statistically significant, the study acknowledges the necessity for sector-specific analysis. The universal applicability of the employed models is also subject to scrutiny due to their development under different geographical conditions and their age. Future research should take these sectoral variations into account and consider the evolution of composite financial performance indicators (bankruptcy models). Alternatively, utilizing a set of individual financial performance indicators may offer a more nuanced understanding of post-merger performance. Finally, the selected period spans over 10 years from 2011 to 2021 and despite the fact the econometric model used is robust and generally capable of extrapolation beyond this period under stable economic conditions, future research could work with longer periods as soon as enough data for 2022 and subsequent years are available. The delay of publication is typically almost two years after the end of the financial year.

Conclusion

The aim of this paper was to answer whether the post-acquisition firm's performance is better than the pre-acquisition performance or whether the firm's financial condition after the merger is better than before the merger. All mergers carried out in 2016 in the Czech Republic were analyzed using the firm's IN05, Altman Z-score, Taffler, and Quick Test composite financial performance indicators data five years before 2016 and five years after 2016. From the original data, the outliers were removed to eliminate companies with extraordinary financial statements, typically operating in a specific industry or performing unusual business activities, which cannot be considered appropriate in the traditional composite financial performance indicators (bankruptcy models), and the companies with uncommon accounting figures in their financial statements. This transformation brings the dataset closer to a normal distribution, strengthening the conclusions of the econometric-statistical methods.

The linear trend mixed effect model was used to compare the dynamics of the development of financial indicators of successor companies with their development in merging companies. The stagnation of merging companies' financial condition is evident from the results for all models; their statistically significant development was not recorded. On the contrary, the increasing trend of IN05, Altman, and Taffler and the decreasing trend for the Quick Test between 2017 and 2021 is pointing to a positive consequence of mergers.

Student's t-test of equality of means was used to compare the levels of IN05, Altman, Taffler, and Quick Test indicators of the merging and successor companies. The indicators levels of the successor companies in 2017 and 2018 are similar to those of the merging companies in all the years under consideration. The situation started to change slightly in 2019 and 2020. A clear improvement of the successor companies compared to the merging ones is shown in 2021. If the entire five-year periods before and after the merger are considered, all models indicate an improvement in successor companies' financial performance.

The conclusions of the analysis are logical, clear, and statistically proven on a significant amount of data, and they are difficult to dispute. However, the analysis has a weak point in that it deals with all companies simultaneously and thus needs a sectoral view. Li and Singal (2021) showed that industrial sector plays a critical role in the performance of mergers and acquisitions. It will, therefore, be followed by a further study in which the companies will be divided by sector, according to the NACE classification, and in each sector separately, the merging and successor companies will be analyzed and compared. However, during the examined period, an extraordinary event occurred: the COVID-19 pandemic and its consequences are partially eliminated just by using all industrial sectors because, on some, it has a positive impact, whereas, on others, it is negative.

Another area for improvement may be in the composite financial performance indicators (bankruptcy models) used. Their specific nature given by particular conditions, i.e., geographical areas, periods, and sam-

ples of companies based on which they were created, can be problematic. Companies used in constructing these models applied different accounting standards, operating in various market and legal environments, and had other financial characteristics compared to the companies to which the models were used in this article. The Altman Z-score model, developed over half a century ago in the US, was based on data from large manufacturing companies. The Taffler model was based on data from UK-traded companies forty years ago. Similarly, the Kralicek Quick Test was developed in Germany thirty years ago and the the Czech IN05 dates twenty years back.

Another question for discussion might be whether z-score models are the best way to measure a company's financial health/distress. Some theoretical arguments favor the market-based option pricing models (e.g., Kealhofer, 2003; Vassalou & Xing, 2004), such as those provided commercially by Moody's KMV (for more details, see: Saunders & Allen, 2002, pp. 46–64). However, there is no evidence of their superior performance in the financial performance (bankruptcy) prediction task compared with the simple z-score approach.

Acknowledgments

The article is prepared as one of the outputs of the research project of the Faculty of Finance and Accounting of the Prague University of Economics and Business, which is implemented under the institutional support of the Prague University of Economics and Business IP100040.

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